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BULLETIN - 1912-1913

Marquette University

College of Applied Science and Engineering

MILWAUKEE, WISCONSIN

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Marquett- University Appl'd Sci. & Eng. 1912-13.

Marquette University

Milwaukee, Wisconsin

Marquette College of Arts and Sciences.

Courses in Letters, Sciences and Philosophy, leading to the Bachelor's degree in Arts and Sciences.

College of Applied Science and Engineering.

Courses in Civil, Mechanical and Electrical Engineering, leading to the degree of Bachelor of Science in Engineering.

Department of Medicine.

A four-year course leading to the degree of Doctor of Medicine.

College of Law, including:

a The Day Law School, a three-year course leading to the degree of Bachelor of Law.

b The Evening Law School, a four-year course preparing for admission to the bar.

School of Dentistry.

A three-year course leading to the degree of Doctor of Dental Surgery.

The R. A. Johnston College of Economics, including:

a The School of Business Administration.

b The School of Journalism.

The School of Pharmacy, including:

a The Short Course in Pharmacy.

b The two-year course leading to the degree of Graduate in Pharmacy.

c The three-year course leading to the degree of Pharmaceutical Chemist.

Department of Music.

Marquette University Conservatory of Music—Instruction in Piano, Vocal, Violin, Violoncello, Organ and all orchestral instruments. Theory and History of Music, Dramatic Art, Elocution and Art of Expression, Public School Music, Ensemble and Sight-Reading.

Marquette Academy.

Preparatory Department, Classical and Commercial Courses, and Courses Preparatory to Law, Medicine and Engineering.

The University Extension Department, including:

a The Evening Classes in Arts and Sciences, and Engineering.

b Lecture Courses, conducted by the Faculties of Arts and Sciences, Engineering Law and Economics.

The Summer School.

Six weeks' session during July and August.

BULLETIN - 1912 - 1913

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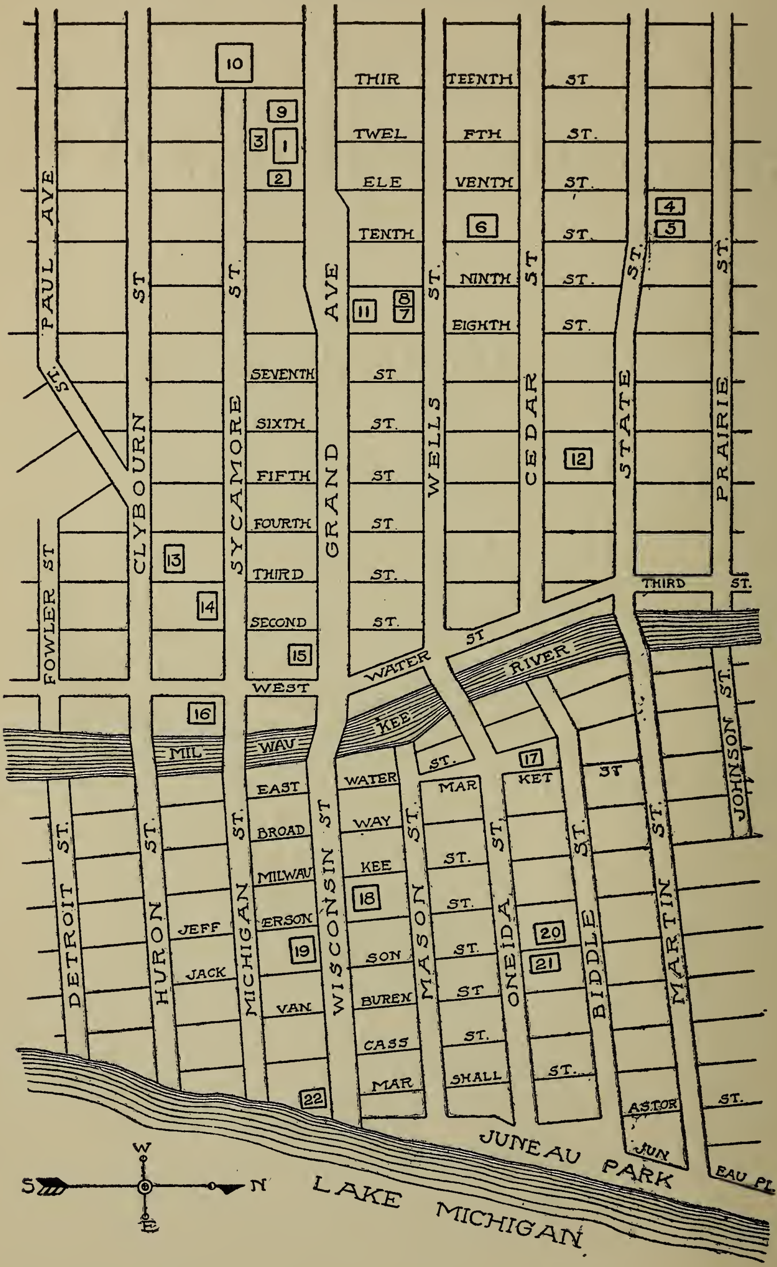
College
of
Applied Science and Engineering

MILWAUKEE, WISCONSIN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LOCATION OF UNIVERSITY BUILDINGS AND OTHER POINTS OF INTEREST.

1. Marquette University—Main Building
    - (a) College of Arts and Sciences.
    - (b) R. A. Johnston School of Economics and Journalism.
2. Department of Law.
3. Department of Engineering.
4. Marquette Athletic Field.
5. Marquette Academy.
6. Department of Music.
7. Department of Medicine.
8. Trinity Hospital.
9. Church of the Gesu.
10. Gesu School and Hall.
11. Public Library.
12. Auditorium.
13. Union Depot (C. M. & St. P.; Soo Line).
14. Interurban Terminal Station.
15. Plankinton Hotel.
16. Goodrich Navigation Company Docks.
17. City Hall.
18. Hotel Pfister.
19. Post-Office.
20. Court House.
21. St. John's Cathedral.
22. Northwestern Depot (C. & N. W.).

CALENDAR.

1912.

Sept. 27, 28, 30.	Examinations for entrance, and for removal of conditions; presentation of certificates.
Sept 30.	Registration Day.
Oct. 1.	Beginning of first semester.
Nov. 28.	Thanksgiving Day.
Dec. 23.	Christmas recess begins.
Jan. 3.	Resumption of classes.
Jan. 27-31.	Final examination of first semester; examinations in conditioned subjects.
Jan. 31.	Registration Day.
Feb. 1.	Beginning of second semester.
Feb. 22.	Washington's Birthday.
March 15-24.	Easter recess.
March 19.	President's Day.
March 25.	Resumption of classes.
May 27-31.	Final examinations of second semester; examinations in conditioned subjects.
May 31.	End of second semester.
June 1-15.	Field work for Civil Engineers at Camp.
June 16-21.	Entrance examinations.
June 21.	Commencement Day.

OFFICERS AND FACULTY.

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AUGUSTINE D. THEISSEN, S. J.	*Instructor in Mathematics*
JACOB A. BICK, S. J.	*Instructor in Physics and Chemistry*
OSCAR BURCKHARDT	*Instructor in Modern Languages*
VICTOR L. IMP	*Asst. Instructor in Mathematics*
VINCENT VOLLMAYER, A. B.	*Assistant in Physics*
PETER N. SAMPON, A. B.	*Assistant in Chemistry*
JAMES ZIMMERMAN, A. B.	*Assistant in Mathematics*

Secretary of the Engineering Faculty, Professor Pinney.

GENERAL INFORMATION

The College of Engineering is the natural outgrowth of the expansion of Marquette University. Its location is fortunate, in being situated in a large manufacturing center; many and varied engineering enterprises are constantly in progress; and the friendly relations between Marquette University and the different shops, factories, and transportation companies give the student advantages that are of great benefit to him in his future career.

There is a strong demand for trained engineers, especially in the Northwest, owing to the industrial activity of that region. To equip men to meet this demand is the object and purpose of the Engineering Department; this equipment demands not only a solid foundation of theory, but above all, thorough drill in the practical applications of theory, to fit the student to grapple with the new and difficult problems he will be likely to meet.

In drawing up the Courses of Study, careful comparison has been made of the courses, and of the actual experiences gained by members of the faculty, in other standard engineering schools. An engineer's training cannot be narrow, and for this reason great importance is attached to English and the modern languages; the relative value assigned to other branches at Marquette is in close accordance with the usage of the prominent Schools and Universities. Every attempt will be made to maintain a high level of study and efficiency, and there is no hesitation in dropping from the rolls students whose application to work is considered unsatisfactory.

BUILDINGS AND EQUIPMENT.

The Engineering Building is situated on Sycamore street, back of the Arts Building; it is a remodelled brick structure of three stories, with a concrete addition. Four large lecture rooms and the Junior Drawing room are situated in the front, with two office rooms for the faculty; (the Dean's office is on the second floor of the Arts & Science Building). The rear addition contains a large, well-lighted Freshman Drawing room; running under the entire building is a basement for laboratory work, containing equipment as presently described; the boiler room is to the rear of the basement. The Chemical and Physical lecture rooms and laboratories are in the Arts and Science Building, on the fourth and third floors respectively.

Laboratory Equipment for Engineering.

1 Riehle 50,000 lbs. universal testing machine.
1 Wire testing apparatus; capacity 500 lbs.
1 Beam testing machine; capacity 300 lbs.
1 Riehle cement machine; capacity 1,000 lbs.
1 High speed 10x10 automatic engine.
1 High speed 5½x7½ automatic engine.
1 Double eccentric 5½x7½ marine engine.
1 10 H. P. horizontal gas engine.
1 3 H. P. gas engine.
1 Pumping station testing plant (4x6x8); Simplex pump.
1 Automobile testing plant.
1 Boiler injector testing rack.
1 Testing rack for testing Indicator springs, thermometers, steam gages, and flow of steam through nozzles.
1 Water meter testing plant.
1 Crosby gage tester.
3 5x16 high pressure return tubular boilers.
2 4x12 Tire Box Boilers. (These furnish the heating plant of the adjacent University buildings.)

The testing apparatus mentioned above is employed in studying the physical properties of all building materials, metal and timber beams, etc., and includes all necessary auxiliary equipment. The 5x7 automatic engine and the double eccentric Marine engine are arranged with water-cooled friction wheels, indicator piping, and exhaust to a condenser. The gasoline engine is belted to a generator and serves as a complete gasoline electric power plant; a Prony brake affords independent tests on the engine.

In the pump testing plant, any desired pressure is obtained by means of valves on the feed and discharge piping of the pump; the two graduated receiving tanks return the water to the reservoir tank.

The automobile plant is designed to receive automobiles of any type and power, and allows their operation to be studied while running under all road conditions; a specially designed dynamometer measures the tractive effort of the rear wheels.

The arrangements of the boilers is such as to permit tests on one or more without interruption to the action of the others. The 10x10-inch high speed automatic, and the Corliss engine are each belted to separate generators and the piping arrangements permit each to be operated by any one of the boilers, thus providing two separate and distinct types of power plants; the load is obtained from a light line, or a water rheostat. Both engines have water-cooled friction wheels, and Prony brakes.

Electrical Equipment.

1—50 K. W. Allis-Chalmers' D. C. Generator.
1—40 K. W. Northern Electric D. C. Generator.
1—6 K. W. Allis-Chalmers' D. C. Generator.
1—2½ H. P. Westinghouse series Motor.
1—15 H. P. Westinghouse Shunt Motor.
1—1 H. P. Crocker-Wheeler Shunt Motor.
1—½ H. P. Crocker-Wheeler Rotary Convertor.
1—15 H. P. Triumph Electric Rotary Convertor.
1—10 H. P. Westinghouse Single Phase Motor.
1—½ H. P. Westinghouse Single Phase Motor.

All instruments necessary for conducting tests on this apparatus for power delivered, machine losses, etc., are available. The electrical plant furnishes light and current to the adjacent University buildings.

Chemical Equipment.

The chemistry lecture room and laboratories occupy the fourth floor of the main building.

The lecture room has a capacity of sixty students and is equipped with fume chamber for demonstrations, the lecture table being supplied with necessary gas, water and electrical connections.

The laboratories have concrete floors throughout and are well lighted. They contain tables with locker equipment for one hundred and twenty-eight students, each locker being furnished with the necessary glassware; apparatus to replace that broken, or for special experiments, may be drawn from the stock room.

The tables are supplied with water and gas connections. Each table has connections to 110 V. Direct and 110 V. and 220 V. alternating electric currents.

The balance room contains three Sartorius balances, and a sufficient number of others less sensitive to supply all wants.

The equipment for quantitative and applied analysis includes the necessary graduated glassware, electrodes and stands for electrolytical analysis; stills for analysis of water; Hempel's, Elliot's, and Orsat's gas pipettes, calorimeter, combustion furnaces, etc.

Physical Equipment.

The Physics Department occupies the third floor of the Arts and Science Building. It comprises a commodious lecture hall, an office and library, and four laboratories. The lecture hall is provided with the usual facilities for experimental illustration. The laboratories are equipped with instruments of precision, such as cathetometer, micrometer, microscope, chronograph, ballistic and Kater pendulums, air thermometer, spectroscope, interferometer, as well as with all the apparatus required in the course of general physics of the Sophomores, and the advanced work of the Juniors. Elementary physics is taught in the Marquette Academy, the preparatory department of the University; and it is one of the required units for admission to the College of Engineering. In the sophomore year the text used is Carhart's University Physics; the juniors make use of various authors and printed notes in their special work.

Evening Courses,

both advanced and elementary are conducted by the Engineering Department in conjunction with the College of Arts and Sciences. During the past year, general courses in Astronomy, Chemistry, English, German, French, Elementary and Higher Mathematics, Mechanical Drawing and Physics were offered; a fuller account will be found in the "Bulletin of Evening Courses of Marquette University." These courses are of advantage to prospective students, or to those working for degrees.

Summer Courses

are likewise offered at Marquette University (in July and August). They are attended chiefly by teachers from other schools, but afford at the same time an opportunity to conditioned or prospective students for making up their deficiencies. A separate "Bulletin of Summer Courses" can be had from the Registrar's office.

Special Lectures

by engineers, faculty members, and invited guests are given to the engineering students at intervals during the year; many of these lectures are illustrated. Among those who have recently addressed the Engineering students are the following:

Mr. W. G. Bruce (President of Milwaukee Harbor Commission).
Mr. J. F. DeVoy, M. E. (Mech. Eng. C. M. & St. P. R. R.).
Mr. W. R. McGovern, A. B. (Eng. Wis. Telephone Co.).
Mr. S. A. Greeley, C. E. (in charge Milw. Garbage Destr. Plant).
Mr. G. C. Teeple, A. B., M. E. (Whitewater, Wis.).
Mr. F. A. Vaughn (Consulting Electr. Eng.).
Mr. R. L. Wardell (Kueffel & Esser Co.).
Mr. E. E. Adams, M. E. (Allis-Chalmers Co.).
Mr. Isham Randolph, C. E. (Consulting Eng., Chicago, Ill.).
Mr. O. M. Rau (Ex-Electr. Eng., T. M. E. R. & L. Co.).

Mr. C. N. Duffy (Comptroller, T. M. E. R. & L. Co.).

Professors Davis, Pinney and McGeary have given illustrated lectures on special topics.

REQUIREMENTS FOR ADMISSION.

Admission to the College of Engineering is by means of entrance examinations, or by the presentation of credits as specified below. Applicants must be at least sixteen years of age, and possess satisfactory testimonials of their good moral character. If they are graduates of High Schools on the approved list of this University, they are admitted on the credits which their graduation gives. For admission, 14 units from the following list must be offered: (one unit corresponding to 5 hours a week for one year, i. e., a minimum of 180 recitation periods). The first seven units are obligatory, with the exception that Solid Geometry may, under certain circumstances, be regarded as a condition, to be removed within an assigned time during the Freshman year. Ample opportunity for this is given at Marquette Academy. Students are requested to send in their credits as soon as possible.

Subjects.

REQUIRED:	UNITS.
Elementary Algebra	1½
Plane Geometry	1
Solid Geometry	½
English Composition English Literature	2
History	1
Elementary Physics	1
Total	7

The other seven units may be made up from the following list:

Subjects.

ELECTIVE:	UNITS.
Languages:	
Latin	1-4
French	1-4
German	1-4
Greek	1-3
Spanish	1-2
English	1-2

Advanced Algebra	½
Trigonometry	½
History Civics	1-3
Elementary Sciences	1-4
Vocational Subjects and Manual Training	1-2

Description of Required and accepted subjects.

(a) *Latin*—

1. The requirements are those of the standard beginners' texts, such as Bennett's Foundations, Collar & Daniell, or Miller & Beeson; simple etymology and syntax; easier themes.
2. 4 books of Caesar, or equivalent; themes.
3. 6 orations of Cicero or equivalent; higher syntax of moods and tenses.
4. Vergil, 6 books, or equivalent, with prosody, mythology, and erudition.

(b) *Greek*—

1. Any standard beginners' text, such as White's First Greek book, and one book of Xenophon; easier forms and syntax.
2. Two books of Xenophon, three of Homer, or equivalent, with syntax and themes.
3. The equivalent of three books of Xenophon, and six of Homer, with grammar and erudition.

(c) *French, German*—

1. Elementary grammar, easy prose and themes.
2. Syntax, moods, complex sentences, easy prose writing.
3. Good reading knowledge of standard prose, with syntax.
4. Acquaintance with classics and lyric poets.

The texts this year at Marquette are Chardenal (French), and Becker (German). Equivalent text-books must be used by students.

(d) *Spanish*—

(Same as for first two years of German and French.)

(e) *English*—

The division of English into four-year courses differs so widely that no definite plan can be outlined. A text like Scott and Denny would fill the requirements, as would the equivalent texts and assigned readings of any approved High School. The student must specify his text and readings, and the examination will be in accordance with these; a short essay or composition will be assigned likewise, to test his knowledge of principles.

(f) *Algebra*—

Fundamental operations, factoring, fractions, linear equations, radicals and exponents, quadratics, graphs, and problems involving all these are required; additional work in logarithms, elementary series, simultaneous quadratics, ratio and variation, binomial theorem, may be offered as ½ unit.

(g) *Trigonometry*—

The six functions, and their relations, addition theorems, simpler transformations, and the solution of plane triangles, right and oblique.

(h) *Geometry*—

Any standard text; original demonstrations, loci, and numerical work are of great importance.

(i) *History and Civics*—

1. United States, or English history.
2. Ancient History.
3. European History.

Civics counts as ½ unit and may be combined with History.

(j) *Elementary Sciences*—

The requirements are those of the standard High School texts, such as "McPherson and Henderson" (in Chemistry); "Martin" (in Physiology), "Linville and Kelly" or "Jordan & Kellogg" (in Zoology); "Atkinson" or "Bergen" (in Botany); "Milliken and Gale," or "Mann and Twiss" or "Carhart and Chute" (in Physics); "Davis" or "Tarr" (in Physical Geography); "Howe" or "Todd" or "Young" (in Astronomy); "Norton" or "Tarr" (in Geology). Work in Biology (e. g., "Bailey & Coleman") may be offered as ½ unit in Zoology and ½ unit in Botany. All notes, note books, laboratory work, etc., in the above subjects, must be presented, especially in Physics, Chemistry and Geology, where they are absolutely required as essential to a proper course.

(k) *Vocational Subjects*—

such as Drawing, Commercial Law, Commercial Geography, Bookkeeping, and Manual Training, are accepted with reluctance. A student offering such credits must furnish a comprehensive and full account of these studies and of the number of recitation or class hours spent in them, together with specimens of work done. Tests may be exacted if any doubt remains; and in no case will the total credits allowed in this group be more than 2.

Admission may likewise be had by transfer from another recognized College or University, on presentation of an official statement of the student's standing, and a certificate of honorable dismissal.

Applicants, not graduates of an accredited high school or transferred in good standing from an institution of equal rank, are subject to entrance examinations, which are held in September and June—(see Calendar, page 4). Detailed information as to the hour and place of such examinations will be furnished to applicants at the Registrar's office.

Special Students, not candidates for a degree, may be admitted to certain courses, provided they are over 19 years of age, and show the ability to pursue their studies with profit. The credit to be assigned for such work will be determined upon by the Head of the Department, and the Dean of the Engineering school.

REGULATIONS.

Every student shall carry not less than 14 credit hours of the work prescribed for the class in which he registers; if not, he will be classed as a special student. Reports are sent to parents and guardian at regular intervals concerning his standing and progress.

A final average below 51 for a semester's work in any subject will be considered a failure, and the student will be required to repeat the semester's work for that subject. A final average above 51 and below 67 in any subject, conditions the student. This condition may be removed by a special examination, to be taken not later than the beginning of the second semester following the one in which the condition was incurred. Failure to remove the condition within this time will require the student to repeat the semester's work in the conditioned branch. Examinations for the removal of conditions will be held in September, January and June and for each examination there is a special fee of $1.

A student who fails to complete his laboratory or drawing assignments within the time prescribed, will have his credits in such uncompleted subjects withheld until he has completed all work to the satisfaction of the professor in charge. In case of failure to complete this work by the end of the next succeeding semester, the semester's work in this uncompleted subject must be repeated.

Any student desiring special consideration, or exceptions from the above rules, must present his request in writing, with reasons, to the faculty, through the Dean of the Department; and all such exceptional cases will be considered by the faculty as a whole, at a regular meeting.

One unexcused absence for each credit hour in any course will be allowed to a student. He will be considered absent if he fails to appear during time of class, or leaves before the class is dismissed. A student who is absent from class must give satisfactory explanation to the instructor in charge, and arrange with him for making up the lost work; in case of excused absences from class-tests, an opportunity to make them up will be given at the end of each semester.

Any student who exceeds the allowed number of unexcused absences may be dropped from the course at the discretion of the faculty, the case being considered at a regular faculty meeting.

Continued carelessness and neglect of work, improper or ungentlemanly conduct, and dishonesty in examinations are regarded as sufficient reasons for terminating the connection of a student with this University.

Degrees.

The degree of Bachelor of Science in Civil, Mechanical or Electrical Engineering, is conferred on those who have successfully completed the work outlined in the following courses of study. A thesis embodying original work is an integral part of the student's qualifications for this degree. The professional degrees of Civil Engineer, Mechanical Engineer, Electrical Engineer, are conferred on graduates of the Engineering College of Marquette University, who during three years subsequent to graduation have proven their standing and ability by professional work or by original research, contributions to scientific journals, or professorial work. The applicant for a professional degree must present to the Dean of the Engineering Department during the month of October, a statement of his work and experience, and announce the subject of his thesis. An outline of the thesis must be submitted for approval, and the completed thesis must be in the hands of the faculty by April 1st.

Graduate study in this University, or any other of equal rank, may be accepted as part of the requirements for a professional degree. No other degrees are at present conferred in the Engineering Department, besides those specified above.

Expenses and Fees.

The annual tuition fee is $100, payable in two equal instalments, on October 1st and February 1st, with ten days of grace. At the expiration of that time, non-payment debars the student from class. The matriculation fee is $5, and the Diploma fee $5. Laboratory deposits of $5 and

$10 are required to provide against loss and breakage. Camp expenses for the civil engineers will amount to $15.

Tuition once paid is not refunded, nor is a rebate granted; a student, however, who leaves this College for valid reasons during the year, may redeem the unpaid tuition by pursuing his departmental studies within one year from the date of his withdrawal.

The College provides no dormitory system for students. Information as to rooms and board may be had at the Registrar's office; the expenses for these need not amount to more than from $4 to $6 per week. There is also an Employment Bureau, for the assistance of students who are working their way through the University.

A book store is maintained in the University buildings, where all necessary books and supplies may be obtained at current rates.

STUDENT ORGANIZATIONS.

The social life of the University is fostered by the following literary, musical and athletic societies:

Marquette Engineering Association.

This society was organized in January, 1909. Its object is expressed in the first article of the constitution as follows:

"First, to promote the general welfare of the Marquette University; second, to advance the interests of the Engineering Department; third, to promote intellectual pursuits in Engineering; fourth, to establish friendship between fellow members; fifth, to promote athletic contests with other departments of the University."

The officers are President, Vice-President, Secretary and Treasurer, Corresponding Secretary, and an Executive Committee of five members.

Marquette Oratorical Association.

Was organized in November, 1883. Its principal object is to prepare the student for public speaking and to store his mind with a fund of facts and arguments on questions of history and literature. The Moderator is appointed by the Faculty, the other officers are chosen by the members.

Marquette University Mandolin Club.

Mandolins, 10; Guitars, 2; Violins, 7; Flutes, 2; Cornet, 1; Clarinet, 1; Violoncello, 1; Double-bass, 1; snare-drum, 1; Timpani and Piano.

Marquette University Brass Band.

The Marquette University Brass Band has a select membership of thirty this year, and is conspicuous at all athletic and public events.

Glee Club.

Students in any of the University departments, having the necessary qualifications, are eligible to membership in the Glee Club. Two half-hour periods weekly are given to vocal culture, accompanied by instruction in musical theory and correct interpretation. Four part compositions of medium difficulty form the basis of the exercises. There are no fees attached to membership, or charges for instruction; but regularity in attendance at club rehearsals is imperative, and an absolute condition of membership.

A special function of the Glee Club is to furnish the vocal music at University exercises.

Marquette University Athletic Association.

The object of this association is to furnish the students with the best facilities for the promotion of general athletics. Realizing the necessity of suitable recreation and relaxation of both mind and body for those engaged in mental pursuits, the University authorities have at all times encouraged manly sports among the students. However, only those who are regular in class attendance and up to the standard in class work are allowed to take part in athletic contests in which the University is represented.

The removal of the old Library and Gymnasium from the grounds at State and Eleventh streets has made possible the conversion of these grounds into the Marquette University Campus. This is at the disposal of the students of all the Departments and is within easy access of all. The campus is of regulation size for both football and baseball.

The *Marquette University Journal* is published by the University five times a year, on the 25th day of every second month. It affords students an opportunity of literary expression, serves as a channel of communication between past and present students, and chronicles all University events. Important professional articles by members of the Faculty appear from time to time.

PLAN OF STUDY.

Leading to a Degree of B.S. in C.E.

FIRST YEAR.

	Class Work	Credit Hours	Class Work	Credit Hours
Algebra (M. 6)	5	5	0	0
Analytic Geometry (M. 7)	0	0	5	5
Chemistry (C. 2)	5	3	5	3
Drawing (D. 1, 3)	8	3	8	3
English (L. 1, 2)	3	3	3	3
French, German (L. 11, 21)	4	4	4	4
Surveying (C. E. 1)	3	1	3	1
†Trigonometry (M. 5)	3	3	0	0

SECOND YEAR.

Calculus (M. 8)	5	5	2	2
Chemistry (C. 4, 5)	6	2	6	2
Descriptive Geometry (D. 5)	6	3	0	0
Drawing (D. 4)	0	0	4	2
Mechanics (Mech. 1)	0	0	5	5
Surveying (C. E. 2)	5	3	5	3
Physics (P. 2, 3)	7	5	7	5

THIRD YEAR.

Bridge Engineering (C. E. 10)	2	2	2	2
Bridge Engineering (C. E. 11)	0	0	6	3
Geodesy and Least Squares (C. E. 3; M. 19)	2	2	0	0
Hydraulics (Mech. 3)	0	0	5	5
Materials Testing Laboratory (Mech. 101, 102)	4	2	4	2
Mechanics (Mech. 2)	5	5	0	0
Physics (P. 6, 7)	6	3	6	3
Structural Design (C. E. 8)	6	3	0	0
Railroad Engineering (C. E. 4)	5	3	5	3

FOURTH YEAR.

*Applied Chemistry (C. 112)	4	2	4	2
Bridge Engineering (C. E. 12)	4	2	4	2
*Bridge Engineering (C. E. 13)	1	1	1	1

*Electrical Engineering (E. E. 1, 2)	3	3	3	3
Masonry and Foundations (C. E. 7)	3	3	0	0
*Mechanical Laboratory (M. E. 112)	4	2	4	2
Reinforced Concrete (C. E. 14, 15)	0	0	6	4
Steam and Gas Engineering (M. E. 8, 9)	3	3	3	3
Railroad Engineering (C. E. 5, 6)	5	3	5	3
Thesis (C. E. 16)	0	3	0	3

†Trigonometry is a required subject for students who have not had a satisfactory course in it previous to entrance.

*Students must take as many hours of elective as are required to make a total of 19 credit hours.

PLAN OF STUDY.

Leading to a Degree of B.S. in M.E.

FIRST YEAR.

	Class Work	Credit Hours	Class Work	Credit Hours
Algebra (M. 6)	5	5	0	0
Analytic Geometry (M. 7)	0	0	5	5
Chemistry (C. 2)	5	3	5	3
Drawing (D. 1, 2)	8	3	8	3
English (L. 1, 2)	3	3	3	3
French, German (L. 11, 21)	4	4	4	4
Surveying (C. E. 1)	3	1	3	1
*Trigonometry (M. 5)	3	3	0	0

SECOND YEAR.

Calculus (M. 8)	5	5	2	2
Chemistry (C. 4, 5)	6	2	6	2
Descriptive Geometry (D. 5)	6	3	0	0
Drawing (D. 4)	0	0	4	2
Kinematics (M. E. 1)	0	0	5	3
Mechanics (Mech. 1)	0	0	5	5
Physics (P. 2, 3)	7	5	7	5
Surveying (C. E. 2)	5	3	0	0

THIRD YEAR.

Electrical Engineering (E. E. 1, 2)	3	3	3	3
Hydraulics (Mech. 3)	0	0	5	5
Machine Design (M. E. 2, 3)	6	3	6	3
Mechanical Lab. (M. E. 108, 109)	4	2	4	2
Mechanics (Mech. 2)	5	5	0	0
Physics (P. 6, 7)	6	3	6	3
Steam and Gas Engineering (M. E. 8, 9)	3	3	3	3
Materials Testing Laboratory (Mech. 101, 102)	2	1	2	1

FOURTH YEAR.

Applied Chem. (C. 108, 109, 110, 111)	4	2	4	2
Bridge Engineering (C. E. 10)	2	2	2	2
Electrical Lab. (E. E. 101)	4	2	4	2
Mechanical Lab. (M. E. 110, 111)	4	2	4	2
Power Plant Design (M. E. 7)	0	0	6	3
Power Plant Operation and Construction (M. E. 6)	3	2	0	0
Steam and Gas Engineering (M. E. 10, 11)	3	3	3	3
Steam Engine Design (M. E. 5)	6	3	0	0
Structural Design (C. E. 8, 9)	4	2	4	2
Thesis (M. E. 30)	0	1	0	3

*Trigonometry is a required subject for students who have not had a satisfactory course in it previous to entrance.

PLAN OF STUDY.

Leading to a Degree of B.S. in E.E.

FIRST YEAR.

	Class Work	Credit Hours	Class Work	Credit Hours
Algebra (M. 6)	5	5	0	0
Analytic Geometry (M. 7)	0	0	5	5
Chemistry (C. 2)	5	3	5	3
Drawing (D. 1, 2)	8	3	8	3

English (L. 1, 2)	3	3	3	3
French, German (L. 11, 21)	4	4	4	4
Surveying (C. E. 1)	3	1	3	1
*Trigonometry (M. 5)	3	3	0	0

SECOND YEAR.

Calculus (M. 8)	5	5	2	2
Chemistry (C. 4, 5)	6	2	6	2
Descriptive Geometry (D. 5)	6	3	0	0
Drawing (D. 4)	0	0	4	2
Kinematics (M. E. 1)	0	0	5	3
Mechanics (Mech. 1)	0	0	5	5
Physics (P. 2, 3)	7	5	7	5
Surveying (C. E. 2)	5	3	0	0

THIRD YEAR.

Electrical Engineering (E. E. 1, 2)	3	3	3	3
Hydraulics (Mech. 3)	0	0	5	5
Machine Design (M. E. 2, 3)	6	3	6	3
Mechanical Lab. (M. E. 108, 109)	4	2	4	2
Mechanics (Mech. 2)	5	5	0	0
Physics (P. 6, 7)	6	3	6	3
Steam and Gas Engineering (M. E. 8, 9)	3	3	3	3
Materials Testing Laboratory (Mech. 101, 102)	2	1	2	1

FOURTH YEAR.

Bridge Engineering (C. E. 10)	2	2	2	2
Electrical Engineering (E. E. 3, 4)	3	3	3	3
Electrical Laboratory (E. E. 101)	4	2	4	2
Electrical Design (E. E. 5, 6)	6	3	6	3
Mechanical Lab. (M. E. 110, 111)	4	2	4	2
Power Plant Design (M. E. 7)	0	0	6	3
Power Plant Operation and Construction (M. E. 6)	3	2	0	0
Steam and Gas Engineering (M. E. 10)	3	3	0	0
Structural Design (C. E. 8)	2	1	2	1
Thesis (E. E. 7)	0	1	0	3

*Trigonometry is a required subject for students who have not had a satisfactory course in it previous to entrance.

DESCRIPTION OF COURSES

CHEMISTRY.

Professor Bauer.
Mr. Bick.
Mr. Sampon.

2. General Chemistry.

A course of two lectures and one three-hour laboratory period per week. The fundamental laws and theories of chemistry. The elements; symbols and chemical formulae; the development of the chemical formula; chemical equations; the laws of Avogadro, Charles, and Boyle; changes of gas volumes; gas densities; Gay Lussac's law of combining volumes; ionic theory; equilibrium; metallic and non-metallic elements and their compounds. The laboratory course includes 65 experiments.

Text: *Remsen's* College Chemistry, or *Kahlenberg's* Outlines of Chemistry.

Professor Bauer.

3. General Chemistry and Qualitative Analysis.

A course of three lectures and two three-hour laboratory periods. This course covers general inorganic and qualitative chemical analysis. Taken by students of chemistry course or by Engineering students who have advanced standings in some other subject.

Text: Inorganic—*Remsen's* College Chemistry, or *Kahlenberg.*
Analysis, *Noyes*—A system of Qualitative Analysis.

Professor Bauer.

3. Analytical Chemistry—Qualitative Analysis.

A course of two three-hour periods weekly of class room and laboratory instruction. Includes the chemistry of the metals, their most important salts, the explanation of the various chemical groups, and of the methods of separation and detection of the common metallic and of certain rare elements; the analysis of the acid radicals; solution of ores, minerals, rocks, alloys and inorganic substances in presence of organic matter.

Text: *Noyes*—System of Qualitative Analysis supplemented by laboratory notes.

Professor Bauer.

5. Quantitative Analysis.

A course of two three-hour laboratory and class room periods. Through individual laboratory instruction, great stress is laid upon care and accuracy. The course is divided into two parts. The first half is devoted to gravimetric, and the remaining time to volumetric analysis.

(a) *Gravimetric.* A selected number of determinations of basic and acid constituents to illustrate the different conditions of precipitation; washing, drying, and weighing of precipitates; followed by methods of precipitation. The electrolytic determination of copper is included.

(b) *Volumetric.* The use and calibration of volumetric apparatus; selection and use of indicators; making and standardizing of volumetric solutions; a selected number of determinations by acidimetric, alkalimetric, oxidimetric and precipitation methods.

Text: *Talbot's* Quantitative Chemical Analysis.
Supplemented by laboratory notes.

Professor Bauer.

6. Organic Chemistry.

A course of two lectures, one recitation, and two three-hour laboratory periods. Includes the apparatus and operations involved in organic chemical work; fractional distillation; extraction; crystallization; steam distillation; and determination of melting and boiling points; the general principles and theories of organic chemistry, and the physical and chemical properties of compounds of the aliphatic and aromatic series. The student prepares from twenty-five to thirty organic compounds.

Texts: *Remsen's* Organic Chemistry.
Perkin & Kipping Organic Chemistry.

Professor Bauer.

7. Organic Chemistry.

A continuation of previous course, including a large amount of reference and laboratory work. The laboratory work includes elementary organic analysis; two four-hour periods.

Professor Bauer.

108. Fuel Analysis.

The analysis of coal and coke. The determination of carbon, volatile and fixed; sulphur; ash; calorific value by calorimeter determination. Elementary analysis for carbon, hydrogen and nitrogen; calculation of calorific value. Thirty laboratory hours for M. E. and E. E. Seniors.

Professor Bauer.

109. Gas Analysis.

The analysis of fuel and illuminating gases for carbon dioxide, hydrocarbons, oxygen, carbon monoxide, hydrogen, methane and nitrogen, by means of Hempel's and Orsat's apparatus. Calculation of calorific values. Thirty laboratory hours for M. E. and E. E. Seniors.

Professor Bauer.

110. Iron and Steel Analysis.

The metallurgy and production of iron and steel; the testing of percentage of iron in iron ore, the percentage of maganese, sulphur, silicon and carbon in iron and steel; the effects of these elements. Analysis of limestones and Portland cements for silica, iron and aluminum oxides, magnesia, lime, alkalies, anhydrous sulphuric acid, and total sulphur. Analysis of alloys and Babbit metals. Thirty laboratory hours for M. E. and E. E. Seniors.

Professor Bauer.

111. Water Analysis (Industrial).

The analysis of water for total solids, chlorides, silica, magnesia, lime, iron, alumina; hardness, temporary and permanent; fitness for boiler and other industrial uses. The softening of water. Thirty laboratory hours for M. E. and E. E. Seniors.

Professor Bauer.

112. Water analysis (Sanitary).

The analysis of potable waters, and tests of the methods of sewage purification, including tests for residue; chlorides; nitrogent as ammonia, purification, including tests for residue; chlorides; nitrogen as ammonia, free and albuminoid; nitrogen as nitrates; nitrogen as nitrites; oxygen impurities. For Senior C. E., second semester; one four-hour period a week.

Professor Bauer.

113. Analysis of Oils and Soaps.

The Analysis of Oils—Animal, Vegetable and Mineral; a study of specific gravity; flash and burning points; viscosity; melting points of solid fats; acid value; saponification value; iodine value; Reichert's meissel value; color tests with acids, etc.

The Analysis of Soaps—Determination of water, unsaponified matter, total alkali, free alkali, soluble fatty acids, resins, etc. Two lecture hours and two laboratory periods during first semester; elective.

Professor Bauer.

CIVIL ENGINEERING.

Prof. J. C. Davis.
Prof. J. C. Pinney, Jr.

1. Surveying.

The construction, use and adjustment of the tape, compass, level and transit, supplemented by library work, drawing and reports. After Easter vacation one afternoon of field work with the instruments. Three hours, 2 semesters.

Text: *Breed & Hosmer.*

Professor Davis.

2. Surveying.

The course covers the accurate methods of city, mine, hydrographic and topographic surveying. Special field problems and drawings covering these features are assigned. Particular attention is given to the theory and use of the stadia. Three hours throughout the year.

Text: *Breed & Hosmer.*

Professor Pinney.

301. Field Work at Lake Beulah Camp.

Surveying under actual conditions with the tape, level and transit, in connection with the topographic and hydrographic survey of the Lake Beulah region, is carried on. The men work in parties under the direct charge of Junior Civil Engineers on topographic and hydrographic surveys, measure base lines and construct a triangulation system for control, take observations on the sun and stars for meridian and latitude, construct weirs and take measurements to determine flow of water from the lake, etc. In connection with these results, least square adjustments are studied and applied. Board, room and other expenses require a payment of $15. Six transits and six Y-levels of approved makes, with ample auxiliary apparatus are available for field work.

Professors Davis and Pinney.

3. Geodesy.

A study of the methods of Higher Surveying, with reference to the curvature of the earth, and reductions to sea level. The triangulation system obtained at the Lake Beulah Camp is reduced according to these methods. One hour, 1 semester.

Text: *Breed and Hosmer.*

Professor Davis.

4. Railroad Surveying.

Railroad construction and location; theory of railway curves, simple, compound and transition. Problems in locating turnouts, switches, sidetracks and cross-overs. Methods of cross-sectioning and estimate of quantities. Three hours.

Text: *Webb.*

Professor Pinney.

5. Railroad Construction.

Details of track construction and maintenance, including rails, ties, bridges, culverts, tunnels, yards, building, etc. Three hours.

Text: *Webb.*

Professor Davis.

6. Railroad Economics.

The economics of railway construction, including organization, capitalization, expenses, motive power, track, curvature and grades. Three hours.

Professor Davis.

7. Masonry and Foundations.

Cofferdams, cribs, sheet piling, pumping and dredging, caissons. Open and pneumatic foundations, piles and pile-driving. The use of timber, stone, concrete and steel for foundations; costs. Three hours, 1 semester.

Text: *Fowler's* Foundations.
Baker's Masonry Construction.

Professor Davis.

8. Structural Design.

Prerequisites, Mathematics 7, 8; Mechanics 1.

This course consists of a study in the design of simple joints in wood and steel. Each student is required to design several joints such as are used in actual construction. A complete detail drawing of each joint is required, together with an estimate of all necessary castings, bolts, splice-plates, etc.

First semester: Required of Junior C. E., 6 hours per week in drawing room. Required of Senior M. E., 4 hours per week in drawing room. Required of Senior E. E., 2 hours per week in drawing room throughout the year.

No text used. *Professor Pinney.*

9. Structural Design.

A continuation of course (1) for M. E. & E. E.; the design of the columns and roof trusses of a steel building. This course is given in connection with the course in Power Plant Design, as far as possible.

Second semester: Required of Senior M. E., 4 hours per week drawing room.

No text used. *Professor Pinney.*

10. Bridge Engineering.

Prerequisites: Mathematics 7, 8. Mechanics 1.

Stresses in simple trusses.

This course takes up completely the methods of determining kinds of loads to which they are subjected, such as dead load, live load, snow load, wind load, etc. Both analytical and graphical methods are taken up.

Throughout the year.

Required of Junior C. E. and Senior M. E. & E. E. 2 Rec. per week.

Text: *Merriman & Jacoby, Roofs & Bridges,* parts I and II.

Professor Pinney.

11. **Bridge Engineering.**

Prerequisite, C. E. 8.

This course is essentially a continuation of course 9. Every student is given a different set of conditions and is to design completely a steel roof truss and a plate girder R. R. bridge. The design consists of a full detail drawing and an estimate of material, complying with a set of standard specifications.

Second semester.

Required of Junior C. E., 6 hours per week in drawing room.

Text: *Merriman & Jacoby, Roofs & Bridges,* part III.

Professor Pinney.

12. **Bridge Engineering.**

Prerequisites, C. E. 10, 11.

In this course each student is given a pin-connected R. R. bridge to design completely. A complete detail drawing with a stress sheet in accordance with the most modern practice is required of each student.

Throughout the year.

Required of Senior C. E., 4 hours per week in drawing room.

Text: *Merriman & Jacoby,* part III with supplementary lectures.

Professor Pinney.

13. **Bridge Engineering.**

Prerequisites, C. E. 10.

This course is a study of what are commonly known as Higher, or more properly, Statically Indeterminate Structures. The course consists of determining analytically and graphically the actual deflection of structures under load, the true stresses in members of a redundant system; and the exact, and approximate methods of ascertaining the stresses in arches, swing bridges, continuous bridges, etc.

Throughout the year.

Elective for Senior C. E., 1 recitation per week.

Text: *Merriman & Jacoby,* part IV. with lectures.

Professor Pinney.

14. **Reinforced Concrete.**

Prerequisites, Mechanics 1, 2. C. E. 10.

This course consists of a study of the properties of concrete and the effect on these properties of introducing steel reinforcement. Theoretical formulas are developed and studied, and from them the practical formulas and their application to reinforced concrete design and construction in all its forms, such as beams, columns, floor-slabs, arches, retaining walls, dams, culverts, etc.

Second semester.

Required of Senior C. E., 2 recitations per week.

Text: *Turneaure & Maurer,* Principles of Reinforced Concrete Construction.

Professor Pinney.

15. Reinforced Concrete Design.

Prerequisites, Mechanics 1, 2. C. E. 10.

This is a parallel course with Reinforced Concrete, C. E. 14. Each student is required to design completely a reinforced concrete arch, considering stresses due to dead and live loads, temperature, and stresses due to the shortening of the arch rib. A complete detail drawing is required of each student.

Second semester.

Required of Senior C. E., 4 hours per week in drawing room.

Text: *Turneaure & Maurer,* Principles of Reinforced Concrete Construction.

Professor Pinney.

16. Thesis.

The student may choose his subject, under advice of the professor in charge; frequent opportunities for consultation are afforded, but the work done must show the student's ability and originality, when left to himself, in dealing with problems.

Professors Davis and Pinney.

DRAWING.

Prof. J. C. Davis.
Prof. H. E. Pressinger.
Mr. A. A. Perrine.

1. Elementary Drawing.

Eight drawing room hours per week. The course is designed to give the requisite rapidity and neatness in handling drawing instruments, by drawing from copy plates, by geometrical construction, orthographic and isometric projections and free-hand lettering.

Required of all Freshmen.

Mr. Perrine.

2. Elementary Drawing.

Prerequisite—Drawing 1.

This course consists of eight drawing room hours per week. It is designed to give the student a working knowledge of drawing room methods in preparing detail and working drawing of machine parts, and methods of constructing the fundamental curves for gear teeth.

Required of E. E. and M. E. Freshmen.

Professor Pressinger.

3. Elementary Drawing.

Prerequisite—Drawing 1.

This course consists of eight drawing room hours per week. It is designed to give the student a working knowledge of drawing room methods in preparing detail drawings of machine parts, road sections, standard streets, culverts and truss sections.

Required of C. E. Freshmen.

Professor Pressinger.

4. Advanced Drawing.

Prerequisite—Drawing 1, 2, 3.
Descr. Geom.

This is a course of four drawing room hours per week. The work consists of line shading, stippling, determining shadows cast by given objects, isometric and perspective drawing.

Required of all Sophomores. *Professor Davis.*

5. Descriptive Geometry.

A six hour course extending throughout the first semester, consisting of two lecture periods and three drawing periods on problems relating to the projection of points, lines and surfaces, the intersection of lines and surfaces, and the development of surfaces.

Required of all Sophomores. *Professor Davis.*

ELECTRICAL ENGINEERING.

Mr. Perrine.

1. Theory of Electricity.

Three hours a week during fore part of the first semester, junior year. This is a prerequisite to work in Electrical Engineering proper. A study is made of the phenomena and fundamental laws of currents, magnetism, electro-magnetism, electro-magnetic induction, and alternating currents, including the effect of induction and capacity.

Text: Elementary Treatise on Electricity and Magnetism, by *Foster* and *Porter,* founded on *Joubert's Treatise.*

Mr. Perrine.

2. Direct Current Machinery.

Three hours recitations or lectures a week during the last part of the first semester and the second semester of the junior year. The work is devoted to a detailed study of the fundamental principles of magnetic and electric circuits and their application to the various types of direct current machines. The characteristics of these machines under different conditions of operation, and the selection of the proper type of motor to meet certain given requirements are considered. The various methods of speed control are given special consideration. Numerous problems involving the application of the above principles are given as a part of the course.

Text: *Franklin & Esty,* Elements of Electrical Engineering, Vol. I., and special references.

Prerequisite—Theory of Electricity, E. E. 1.

Mr. Perrine.

3. Alternating Currents, and Alternating Current Machinery.

Three hours a week, during the first semester of the Senior year. This subject begins with a mathematical and physical consideration of the effect of the various quantities in alternating current circuits and of their relations to each other, and how these relations may be graphically and mathematically represented. The alternating current generator, synchronous motor, synchronous cenverter and transformer are taken up in turn; the operating characteristics and the practical application of these machines are considered. The solution of problems involving single and polyphase circuits forms a part of the course.

Prerequisite—Direct Current Machinery, E. E. 2.

Mr. Perrine.

4. Alternating Current Machinery and Power Distribution.

Prerequisite—E. E. 3.

This work is essentially a continuation of the work of the previous semester and consists of a study of single phase and polyphase induction and the single phase series motor. Both the theory and operating characteristics are studied so as to show why they are especially fitted to execute the particular class of service which they are required to perform. The work in distribution of electrical energy consists of a study of the size, weight and tensile strength of the various materials used in a transmission line. The line constants are determined, and the choice of voltage and frequency are considered.

Text: *Franklin ond Esty.* *Mr. Perrine.*

5. Direct Current Machine Design.

Senior year, first semester; one hour a week lectures, and five hours computation and drawing. The design of an electro-magnet and a dynamo or motor, is completely worked out, and all required design constants given. From data thus obtained each student is required to complete the numerical calculations for the design of a particular dynamo. A different problem is furnished each student, and complete working drawings and specifications are required with each problem.

Prerequisite—Direct Current Machines, E. E. 1, 2.

Special references, *S. P. Thompson,* Dynamo Design.

Mr. Perrine.

6. Alternating Current Machinery Design.

Senior year, second semester, six hours per week lectures and computation. This subject embraces the elementary principles underlying the design of alternating current apparatus. The design of a transformer and an alternating current generator or motor is completely worked out and all design constants given. From data thus obtained each student is required to complete the numerical calculations for the design of a particular transformer and generator or motor. The work is individualized so that there is the greatest possible independence and responsibility in the application of the principles of design. A complete drawing is required, from each student, showing all necessary details of the apparatus designed.

Prerequisites—Direct Current Machine Design.
Alternating Currents and Alternating Current Machinery, E. E. 2, 3, 4.

Mr. Perrine.

101. Electrical Laboratory.

The laboratory work is intended to supplement the course given in the study of direct and alternating currents, by showing the application of the theoretical principles to actual problems, and to the methods of carrying on commercial tests. The student is required to make all electrical connections with the necessary instruments in the circuit, and to record the required data. From these laboratory records of the experiment performed, a written report is required, with such data, curves and conclusions as would be needed in a full and complete account of the subject under investigation.

Mr. Perrine.

7. Thesis.

The subject for thesis investigation will be assigned by the head of the department at the beginning of the second semester. The thesis may, at the discretion of the student, involve either an experimental investigation, or an original design with complete drawings and specifications. The student must begin his work promptly after an assignment has been made.

MATHEMATICS.

Professor Frumveller.
Assistant Professors Kircher and Theissen.

5. Trigonometry.

The functions and their relations; functions of the sums, differences and multiples of angles; solution of all cases of plane and spherical triangles. Emphasis is laid on the practical side.

Text: *Wentworth or Conant.* Three hours first semester.

Asst. Professor Theissen.

6. Advanced Algebra.

A thorough but brief review of the foundations is given,—(negative and irrational numbers, indices, proportion, graphic and analytic discussion of linear and quadratic equations)—after which the following topics are treated: Permutations and combinations, theory of limits, introduction to theory of series,—(arithmetic, geometric, binomial, logarithmic, series with undetermined co-efficients and their applications, tests of convergence),—elements of theory of equations, complex numbers.

Text: *Rietz and Crathorne.* Five hours first semester.

Professors Frumveller and Kircher.

7. Analytic Geometry.

A thorough study of graphic methods in general precedes this course, after which the line, the individual conics, and the general conic are considered with sufficient completeness. The spirit and methods of analytic geometry are emphasized, and illustrations are drawn from the transcendental and higher algebraic curves whenever possible. The essentials of solid geometry are given.

Text: *Bailey & Woods.* Five hours second semester.

Professor Frumveller,
Asst. Professor Theissen.

8. Differential and Integral Calculus.

The direct and inverse operations are carried on in parallel. The fundamental formulas and methods of differentiating and integrating are followed by a geometric treatment of maxima and minima; then, applications to curves, surfaces and volumes are considered. Taylor's Theorem and the subject of series in general is put into the second semester, together with the applications of Calculus to functions of three or more variables, solid geometry and mechanics. Hyperbolic functions will be treated at some length; much problem work is exacted throughout.

Text: *Townsend & Goodenough.*

Both semesters of Sophomore year.

Professor Frumveller.

17. Differential Equations.

The idea of this introductory course is to bring before the student types of the equations ordinarily met with in physics and mechanics, and to indicate the principles and methods employed for their solution. A certain amount of theory is necessary, but this will not be made the chief feature.

Text: *Campbell's* "Introductory Course" with *Murray* and *Cohen* for reference.

3 hours first semester. *Professor Frumveller.*

19. Errors and Least Squares.

In connection with the Geodetic surveying of the Junior Civil Engineers, a two months' course in Least Squares is given; the theory and formulas are developed rapidly, but sufficiently; and practical adjustments of observations of different or equal precision are then made. The lectures will be based on original notes, with references to Merriman's "Least Squares."

Professor Frumveller.

30. Seminar.

The object of the Seminar is to bring together advanced students for special work, or for original reading, or research in mathematical lines. The proceedings are informal; reports on assigned topics will be made in turn, under the direction of some member of the mathematical faculty.

[N. B.—Elementary courses in Algebra and Geometry are given in Marquette Academy and are in accordance with Engineering entrance requirements.]

MECHANICAL ENGINEERING.

Professor Pressinger.

1. Kinematics.

Prerequisites—Math. 6, 7; D. 1, 2.

Three recitation and lecture hours, extending through the second semester. It includes a systematic study of the forms and motions of mechanism occurring in machines, and the manner of supporting and guiding the parts irrespective of their strength. Also the theory and practice of designing gear teeth and valve motions for steam engines.

Required of Sophomore E. E. and M. E.

Professor Pressinger.

2. Machine Design.

Prerequisites—Math. 7, 8; M. E. 1.
Mech. 1.

One lecture and five drawing hours per week, extending through the first semester. The object of this course is the application of principles already learned to the design of a complete machine. Each student is required to complete the design of a toggle joint or lever press, and of an air or hydraulic cylinder, including the calculation of all stresses and the dimensions of parts. The scope of the lectures includes methods employed in calculating stresses and dimensions; different methods of machining parts, and the properties of materials.

Required of Junior M. E.; Junior E. E.

Text: Elementary Machine design, *Hoffman.*

Professor Pressinger.

3. Machine Design.

Prerequisite—M. E. 2.

A course of one lecture and five drawing room hours per week through the second semester. The course is a continuation of course 2. The student will design some form of power machine, reviewing the simple stresses and including those incident to revolving shafts and gears. The scope of the design is such as to include most of the elementary principles, yet sufficiently limited to enable the student to complete all details.

Required of Junior M. E. and Junior E. E.

Text: Elementary Machine Design, *Hoffman.*

Professor Pressinger.

5. Steam Engine Design.

Prerequisites—M. E. 2, 3, 8, 9.
Mechanics 1, 2.

One lecture and five drawing room hours per week throughout the first semester. The work embraces the design of an automatic cut-off, high speed or Corliss engine. The construction of the theoretical diagrams, and the determining of the leading dimensions of a proposed engine is carried out by each student, after which the details are developed, and working shop drawings are prepared. The scope of the lectures is such as to cover the methods employed. No text is used, but references are furnished.

Required of M. E. Seniors.

Professor Pressinger.

6. **Power Plant Operation and Construction.**

Prerequisite—Steam and Gas Engr., M. E. 8, 9.

This is a three hour course through the first semester. Lectures are given as needed, and inspection trips are made to typical power plants; references are furnished for private readings. From the foregoing the student is expected to gather information enabling him to complete a set of specifications and an operation sheet for a complete power plant.

Required of Senior M. E., Senior E. E.

Professor Pressinger.

7. **Power Plant Design.**

Prerequisite—M. E. 8, 9, 6.

This course consists mainly of six drawing room hours per week. Each student is required to complete working drawings showing the proper location of boilers, piping, engines, auxiliaries, generator and switch board, also drawings and calculations of some of the details. The student is guided in this work by lectures from time to time as needed.

Required of Senior M. E.; Senior E. E.

Professor Pressinger.

8. **Steam and Gas Engineering.**

Prerequisites—Chemistry 2.
Physics 2, 3.
Math. 7. 8.
Mechanics 1.

A course of three recitation and lecture hours per week extending through the first semester, embracing a detailed study of the elementary principles of thermodynamics, mathematically treated; properties of steam; calorimeters and mechanical mixtures; combustion and fuels; boilers and their auxiliaries, and the simple steam engine. The student will supplement this work by solving a number of carefully selected problems, involving the principles studied in the class room.

Required of Junior M. E.; Junior E. E.; Senior C. E.

Text: Heat Engines, *Allen & Bursely.*

Professor Pressinger.

9. **Steam and Gas Engineering.**

Prerequisite—M. E. 8.

Three recitation and lecture hours a week through the second semester. This course includes methods of engine testing; valve motions; reversing gears; valve setting; the various forms of governors; the principles and details of the compound and triple expansion engine. A study is made of the flow of steam through nozzles, and of the DeLaval, Parsons and Curtis Steam Turbines. A careful study is made of the principles and development of two and four cycle internal combustion engines, and the suction and pressure gas producer. The student will supplement this by solving a number of carefully selected problems.

Required of Junior M. E.; E. E. and Senior C. E.

Text: Heat Engines, *Allen & Bursely.*

Professor Pressinger.

10. Steam and Gas Engineering (Thermodynamics).

Prerequisite—Steam and Gas, M. E. 8, 9.

A course of three recitation and lecture hours per week through the first semester. A systematic study is made of the thermal properties and expansion of gases and vapors; thermodynamic processes and cycles, and the kinetic theory of heat. This is followed by a detailed study of steam cycles, steam engines, and steam turbines. The student supplements this by solving a number of carefully selected problems.

Required of Senior M. E.; Senior E. E.

Text: Practical Thermodynamics, *Cardullo.*

Professor Pressinger.

11. Steam and Gas Engineering (Thermodynamics).

Prerequisites—M. E. 8, 9, 10.

One lecture and two recitation hours per week, extending through the second semester. An advanced study and investigation of the combustion of solid, liquid and gaseous fuels; the steam boiler, the hot and internal combustion engines; compressed air, and refrigeration. Parallel references to other texts, etc., are given and each student will make written reports on assignments.

Required of Senior M. E.

Text: Practical Thermodynamics, *Cardullo.*

Professor Pressinger.

108. Mechanical Laboratory.

To accompany M. E. 8.

A course of fifteen experiments, extending through the first semester. The work embraces practice in correcting gages, comparing thermometers, use of the indicator, calibrating meters, setting slide valves, and performing friction tests on steam engines.

Required of Junior M. E.; Junior E. E.

Professor Pressinger.

109. Mechanical Laboratory.

To accompany M. E. 9.

Fifteen experiments extending through the second semester. The work consists of calorimeter tests, the flow of steam through orifices, efficiency tests on oil engines.

Required of Junior M. E.; Junior E. E.

Professor Pressinger.

110. Mechanical Laboratory.

Prerequisites—M. E. 8 and 9.

Fourteen experiments through the first semester. The work consists of evaporative tests of steam boilers under different conditions; and steam consumption and power development of an electric plant.

Required of Senior M. E.; Senior E. E.

Professor Pressinger.

111. Mechanical Laboratory.

Prerequisites—M. E. 8, 9, and 10.

Fourteen experiments through the second semester, consisting of steam pump and injector tests; measurements of the flow of water; tests of automobile engines, and automobiles to determine the power delivered at rear wheels, and the tractive power.

Required of Senior M. E.; Senior E. E.

Professor Pressinger.

112. Mechanical Laboratory.

Prerequisites—M. E. 8 and 9.

This is a course of fourteen experiments in the first semester on calibration of gages; calibration of water meters; tests of steam pumps; the use of the indicator; valve setting and steam and gas engine tests.

Elective for Senior C. E.

Professor Pressinger.

20. Thesis.

At the beginning of the first senior semester the student will select his thesis subject, under approval of the professor. The work must show originality and ability, although frequent opportunity for consultation and advice will be afforded.

MECHANICS.

Professor Davis.
Professor Pinney.
Asst. Professor Kircher.

1, 2. Analytic Mechanics.

Prerequisite—Mathematics 6, 7, 8.

The fundamental laws of motion, and equilibrium are considered; stresses and strains, tension, shearing, compression, torsion, flexure, are thoroughly studied to gain knowledge of the behavior of parts of structures and machines under varying conditions.

Text: *Church's* Mechanics of Engineering, supplemented by printed notes and problems. For reference: *Smith and Longley; Jeans'* Theor. Mechanics. Five hours a week, over two full semesters.

Professor Davis.
Asst. Professor Kircher.

3. Hydraulics and Hydrostatics.

A study of the pressure of water against dams and walls, and of the flow and pressure of liquids in pipes; water wheels and turbines are especially considered, together with hydraulic power development in its various applications.

Text: *Church,* with reference to other texts and printed notes. Five hours a week.

Professor Davis.

101. Materials Testing Laboratory.

Prerequisites—Mechanics 1.
Physics 2 and 3.

A study of the construction and use of the machines and instruments, such as the Cathetometer, Extensometer, Optic Lever, Testing Machines, etc., used in the testing laboratory. The capabilities and uses of the measuring instruments are first taken up and their accuracy determined, after which the testing machines are studied by a short series of class experiments. A complete and carefully written report on each test performed is an essential part of the work.

First semester.
Required of Junior C. E., 4 hours per week, 2 hours credit.
Required of Junior M. E., 2 hours per week, 1 hour credit.
Required of Junior E. E., 2 hours per week, 1 hour credit.

Professor Pinney.

102. Materials Testing Laboratory.

Prerequisite—Mat. Test. Lab. 101.

This is a continuation of Course 101. The students work in parties of two or three, and each party makes about fifteen individual tests in which they determine the strength and properties of cement, brick, steel, copper, brass, cast iron, wrought iron, malleable iron, etc. The true elastic curve of steel and iron is also obtained. A complete and carefully written report on each test performed forms an essential part of the course.

Second semester.
Required of Junior C. E., 4 hours per week, 2 hours credit.
Required of Junior M. E. and E. E., 2 hours per week, 1 hour credit.

Professor Pinney.

MODERN LANGUAGES.

Professor Murphy.
Professor Abrams.

1. English.

The elements of good writing, supply of words, good use and choice of words, propriety, purity, elegance of diction; violations of rule, barbarisms, slang, solecisms, are thoroughly considered. After this, the study is made to bear on analysis of sentences, structure, clearness, precision, strength and harmony, and the periodic construction. Practice; daily written or oral exercises. Frequent original composition.

Three hours first semester. Required of Freshmen.

Text: *Hill's* "Principles of Rhetoric."

Professor Murphy.

2. English.

A continuation of the preceding course; period building, formation of style, figures and ornaments, beauty, taste. Various classes of composition are dealt with; letters, narrations, descriptions, the essay. Oral and written work is constant.

Three hours a week; second semester. Required of Freshmen.

Text: *Hill.* For reference: *Genung, Coppens, Earle's* "Principles of Scientific Writing," *Woolley.*

Professor Murphy.

11. French.

The work begins with oral exercises, and conducts the student through elementary grammar, including the more important irregular verbs; simple French prose should be understood and translated by the end of the year. Easy conversations are introduced.

Professor Abrams.

12. French.

This course continues the preceding work in grammar and syntax, and has for its object the free reading of standard prose; exercises in translation from English into French are frequently assigned. The purpose is to fit the student for wider professional reading.

Text: *Chardenal.* Selected authors.

Professor Abrams.

21. German.

The easier grammatical forms, as far as the irregular verbs are gone over, with translations and practical simple oral work.

Professor Abrams.

22. German.

This course continues the work of No. 21 in syntax and grammar, and by conversations, readings and themes prepared the student to read with some ease the standard German prose.

Text: *Becker,* and selected authors.

Professor Abrams.

PHYSICS.

Professor McGeary.
Mr. Bick.
Mr. Vollmayer.

[1. Elementary Physics,

with laboratory (5 hours), both semesters.

This is an elementary and descriptive course designed to give Academy students a general idea of the principal phenomena and laws of Physics. It is a prerequisite for Sophomores; and as it is not given in the Freshman year of Engineering, it is listed as an entrance requirement. Special students who lack this credit will be allowed to take this course in Freshman year.]

2. Mechanics, Molecular Physics, Sound.

Prerequisite—Trigonometry, and course P. 1.

This course corresponds to the first half of General or College Physics. It calls for a careful analysis of principles and laws, their development, their correlation, and their practical applications. Special attention is given to Mechanics.

Four hours first semester. Required of Sophomores.

Text: *Carhart,* University Physics, Vol. 1.

Professor McGeary.

3. Light, Heat, Electricity.

Prerequisite—Course P. 2.

In the continuation of General Physics the same analytic method is pursued in the discussion of the theories which underlie the phenomena of these subjects, and due emphasis is placed on the important applications of the mechanics of waves and harmonic motion to these phenomena.

Continuation of 2. Four hours second semester. Required of Sophomores.

Text: *Carhart,* University Physics, Vol. II.

Professor McGeary.

102. **Physical Measurements.**

Quantitative determinations of physical constants; adjustments and use of instruments of precision, such as the micrometer, microscope, cathetometer, chronograph, etc. Verification of the laws of impact, of torsion and rigidity, of the composition of harmonic motions, of gravity; Young's modulus, Moment of Inertia, etc. 25 experiments.

Laboratory corresponding to course 2. Three hours first semester. Required of Sophomores.

Professor McGeary.
Mr. Bick.
Mr. Vollmayer.

103. **Physical Measurements.**

Twenty-five experiments covering the laws of refraction; accurate measurements of indices of refraction; critical angle; magnifying power; photometry and spectrum analysis. Determinations of specific heats, coefficients of expansion, laws of gases; hygrometry. Electrostatic induction; theory of condenser; measurement of resistance; efficiency of electric motor; operation of alternator and transformer.

Laboratory corresponding to course 3. Three hours second semester. Required of Sophomores.

Professor McGeary.
Mr. Bick.
Mr. Vollmayer.

6. **Advanced Physics: Sound, Heat, Light.**

Prerequisite—Courses P. 2, 3, 4 and 5; M., 7. 8.

This course goes into the mathematical theories of these subjects as well as the refined methods of modern research; and due attention is given to practical applications in engineering and the industries generally.

Two hours first semester. Required of Juniors.

Professor McGeary.

106. **Measurements in Sound, Heat, Light.**

Prerequisites—Same as course 6.

A laboratory course, coordinate with course 6, in which accurate measurements are made in such phenomena as stationary waves, Lissajous' curves, etc., vapor tension, calorimetry; Spectrometer, diffraction grating, polariscope, bi-prism, photometer and interferometer.

Four hours first semester. Required of Juniors.

Professor McGeary.
Mr. Bick.

7. Electrical Measurements.

Prerequisites—Course P. 5 and M. 8.

The development of electrical theories. The laboratory work includes the calibration of measuring instruments; resistance of conductors, electrolytes, dielectrics, magnetic properties of iron, magnetometer, self-induction, inductance and capacity, high and low potentials.

Six hours, recitations and laboratory; second semester. Required of Juniors.

Professor McGeary.
Mr. Bick.

Acknowledgment.

The President and Faculty wish to express their grateful acknowledgment for donations to the Laboratories of the College of Engineering.

THOMAS J. NEACY, President of Filer & Stowell Co., 100 H. P. Steam engine, Corliss type	$1,500.00
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